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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Kinsman et al.

Serial No.: 09/538,684

Filed: March 30, 2000

For: VARIED-THICKNESS HEAT SINK FOR INTEGRATED CIRCUIT (IC) PACKAGES AND METHOD OF FABRICATING IC PACKAGES

Examiner: D. Graybill

Group Art Unit: 2827

Attorney Docket No.: 3056.1US (96-803.1)

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AMENDMENT UNDER 37 C.F.R. § 1.116

Box AF
Commissioner for Patents
Washington, D.C. 20231

Sir:

This amendment is in response to the Final Refection of the pending claims in the Office Action dated July 1, 2002 whose initial period of response is set to expire on October 1, 2002.

IN THE CLAIMS:

Please note that all claims currently pending and under consideration in the referenced application are shown below, in clean form, for clarity.

A marked-up copy of the amended claims is set forth in Appendix A attached hereto.

Please amend the claims as follows:

1. (Previously Three Times Amended) An integrated circuit package comprising:

a package body;

an integrated circuit die positioned within the package body;

a lead frame including a plurality of leads having portions enclosed within the package body that connect to the integrated circuit die, the plurality of leads having portions enclosed within the package body forming an area; and

an electrically conductive heat sink positioned at least partially within the package body with a surface of a first portion of the heat sink facing the lead frame in close proximity to a substantial part of the enclosed portion of at least eighty percent of the area formed by the plurality of leads of the lead frame having portions enclosed within the package body and with a die-attach area on the surface of the first portion of the heat sink attached to the integrated circuit die, a second portion of the heat sink projecting away from the first portion of the heat sink under the die-attach area and the integrated circuit die, the heat sink coupled to one of a signal voltage and a reference voltage so the heat sink operates respectively as a signal plane and a ground plane for the plurality of leads of the lead frame.

2. (Previously Twice Amended) The integrated circuit package of claim 1, wherein the package body includes one of a transfer molded plastic package body and a preformed ceramic package body.

3. (Previously Twice Amended) The integrated circuit package of claim 1, wherein the integrated circuit die includes one of a Dynamic Random Access Memory integrated circuit die, a Static Random Access Memory integrated circuit die, a Synchronous Dynamic Random Access Memory integrated circuit die, a Sequential Graphics Random Access Memory integrated circuit die, a flash Electrically Erasable Programmable Read-Only Memory integrated circuit die, and a processor integrated circuit die.

4. (Previously Twice Amended) The integrated circuit package of claim 1, wherein the lead frame includes one of a peripheral-lead finger lead frame, a Leads Over Chip lead frame, and a Leads Under Chip lead frame.

6. (Previously Twice Amended) The integrated circuit package of claim 1, wherein the heat sink is coupled to the reference voltage through one of a wirebond, a conductive adhesive, and a welded connection.

7. (Previously Amended) The integrated circuit package of claim 1, wherein the heat sink is electrically isolated from the lead frame.

8. (Previously Amended) The integrated circuit package of claim 1, wherein the heat sink is positioned only partially within the package body.

9. (Previously Three Times Amended) The integrated circuit package of claim 1, wherein the heat sink is coupled to a printed circuit board outside the package body thereby coupled to one of a signal voltage and a reference voltage.

10. (Previously Amended) The integrated circuit package of claim 8, wherein the second portion of the heat sink projects substantially to one of a top and a bottom of the package body.

11. (Previously Twice Amended) The integrated circuit package of claim 1, wherein the heat sink is positioned within the package body with the surface of its first portion in close proximity to substantially all of the enclosed portion of each of the plurality of leads of the lead frame.

12. (Previously Amended) The integrated circuit package of claim 1, wherein the heat sink is positioned within the package body with its first portion extending substantially to at least one side of the package body.

14. (Previously Amended) The integrated circuit package of claim 1, wherein the first and second portions of the heat sink are integral with one another.

15. (Previously Amended) The integrated circuit package of claim 1, wherein the first and second portions of the heat sink comprise separate parts.

16. (Previously Amended) The integrated circuit package of claim 1, wherein the heat sink comprises a plurality of parts, each forming a portion of both the first and second portions of the heat sink.

17. (Previously Amended) The integrated circuit package of claim 1, wherein the surface of the first portion of the heat sink includes a recess in which the die-attach area is located.

18. (Previously Amended) The integrated circuit package of claim 1, wherein the heat sink has locking holes therein for locking the heat sink in the integrated circuit package.

19. (Previously Amended) The integrated circuit package of claim 1, further comprising an adhesive attaching the lead frame to the heat sink.

20. (Previously Amended) The integrated circuit package of claim 1, wherein the integrated circuit package comprises one of a Vertical Surface Mount Package, a Small Outline J-lead package, a Thin Small Outline Package, a Quad Flat Pack, and a Thin Quad Flat Package.

22. (Four Times Amended) An electronic system comprising an input device, an output device, a memory device, and a processor device coupled to the input, output, and memory devices, at least one of the input, output, memory, and processor devices including an integrated circuit package comprising:

a package body;

an integrated circuit die positioned within the package body;

a lead frame including a plurality of leads having portions enclosed within the package body that connect to the integrated circuit die, the plurality of leads having portions enclosed within the package body forming an area; and

an electrically conductive heat sink positioned at least partially within the package body with a surface of a first portion of the heat sink facing the lead frame in close proximity to a substantial part of the enclosed portion of at least eighty percent of the area formed by the plurality of leads of the lead frame having portions enclosed within the package body forming an area and having a die-attach area on the surface of the first portion of the heat sink attached to the integrated circuit die, a second portion of the heat sink being opposite the die-attach area and projecting away from the first portion of the heat sink and the integrated circuit die.

23. (Previously Amended) A lead frame assembly comprising:

a lead frame; and

a heat sink positioned with a surface thereof in a substantially mutually parallel and co-extensive relationship with, and in close but electrically insulated proximity to, the lead frame.

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24. (Four Times Amended) An integrated circuit package comprising:

a package body;

an integrated circuit die positioned within the package body;

a lead frame including a plurality of leads having portions enclosed within the package body that connect to the integrated circuit die, the plurality of leads having portions enclosed within the package body forming an area; and

an electrically conductive heat sink positioned at least partially within the package body with a vertically extending columnar portion surrounded by a horizontally extending skirt portion having a lead frame attachment surface proximate a die-attach surface substantially vertically aligned with the columnar portion, the lead frame attachment surface being attached to the lead frame and extending in close proximity to a substantial part of the enclosed portions of at least eighty percent of the area formed by the plurality of leads of the lead frame having portions enclosed within the package body, the die-attach surface being attached to the integrated circuit die.

25. (Four Times Amended) An integrated circuit package comprising:

an integrated circuit die;

a lead frame including a plurality of leads having portions that are connected to the integrated circuit die, the plurality of leads forming an area; and

an electrically conductive heat sink positioned having a surface of a first portion of the heat sink facing the lead frame in close proximity to a substantial part of an enclosed portion of at least eighty percent of the area formed by the plurality of leads of the lead frame and with a die-attach area on the surface of the first portion of the heat sink attached to the integrated circuit die, a second portion of the heat sink projecting away from the first

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portion of the heat sink under the die-attach area and the integrated circuit die, the heat sink coupled to one of a signal voltage and a reference voltage for the heat sink to operate respectively as a signal plane and a ground plane for the plurality of leads of the lead frame.

26. (Previously Twice Amended) The integrated circuit package of claim 25, further comprising a package body.

27. (Previously Twice Amended) The integrated circuit package of claim 26, wherein the package body includes one of a transfer molded plastic package body and a preformed ceramic package body.

28. (Previously Twice Amended) The integrated circuit package of claim 25, wherein the integrated circuit die includes one of a Dynamic Random Access Memory integrated circuit die, a Static Random Access Memory integrated circuit die, a Synchronous Dynamic Random Access Memory integrated circuit die, a Sequential Graphics Random Access Memory integrated circuit die, a flash Electrically Erasable Programmable Read-Only Memory integrated circuit die, and a processor integrated circuit die.

29. (Previously Twice Amended) The integrated circuit package of claim 25, wherein the lead frame includes one of a peripheral-lead finger lead frame, a Leads Over Chip lead frame, and a Leads Under Chip lead frame.

31. (Previously Twice Amended) The integrated circuit package of claim 25, wherein the heat sink is coupled to the reference voltage through one of a wirebond, a conductive adhesive, and a welded connection.

32. (Previously Amended) The integrated circuit package of claim 25, wherein the heat sink is electrically isolated from the lead frame.

33. (Previously Amended) The integrated circuit package of claim 26, wherein the heat sink is positioned only partially within the package body.

34. (Previously Twice Amended) The integrated circuit package of claim 26, wherein the heat sink is coupled to a printed circuit board outside the package body and is thereby coupled to one of a signal voltage and a reference voltage so the heat sink operates respectively as a signal plane and a ground plane for the plurality of leads of the lead frame.

35. (Previously Amended) The integrated circuit package of claim 34, wherein the second portion of the heat sink projects substantially to one of a top and a bottom of the package body.

36. (Previously Twice Amended) The integrated circuit package of claim 26, wherein the heat sink is positioned within the package body with the surface of its first portion in close proximity to substantially all of the enclosed portion of each of the plurality of leads of the lead frame.

37. (Previously Amended) The integrated circuit package of claim 26, wherein the heat sink is positioned within the package body with its first portion extending substantially to at least one side of the package body.

39. (Previously Amended) The integrated circuit package of claim 25, wherein the first and second portions of the heat sink are integral with one another.

40. (Previously Amended) The integrated circuit package of claim 25, wherein the first and second portions of the heat sink comprise separate parts.

41. (Previously Amended) The integrated circuit package of claim 25, wherein the heat sink comprises a plurality of parts, each forming a portion of both the first and second portions of the heat sink.

42. (Previously Amended) The integrated circuit package of claim 25, wherein the surface of the first portion of the heat sink includes a recess in which the die-attach area is located.

43. (Previously Amended) The integrated circuit package of claim 25, wherein the heat sink has locking holes therein for locking the heat sink in the integrated circuit package.

44. (Previously Amended) The integrated circuit package of claim 25, further comprising an adhesive attaching the lead frame to the heat sink.

45. (Previously Amended) The integrated circuit package of claim 25, wherein the integrated circuit package comprises one of a Vertical Surface Mount Package, a Small Outline J-lead package, a Thin Small Outline Package, a Quad Flat Pack, and a Thin Quad Flat Pack.

REMARKS

Claims 1 through 4, 6 through 12, 14 through 29, 31 through 37 and 39 through 45 are currently pending in the application.

This amendment is in response to the Final Rejection in the Office Action of July 1, 2002.

Claims 1, 2, 4, 6, 8 through 12, 14 through 20, 24 through 27, 29, 31, 33 through 37 and 39 through 45 were rejected under 35 U.S.C. § 102(b) as being anticipated by Marrs (U.S. Patent 5,701,034) or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Marrs.

Claims 3, 22 and 28 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Marrs as applied to claims 1, 2, 4 through 6, 8 through 20, 24 through 27, 29 through 31 and 33 through 45, and further in combination with Wark (U.S. Patent 5,696,031).

After carefully considering the cited prior art, the rejections, and the Examiner's comments, Applicants have previously amended the claimed invention to clearly distinguish over the cited prior art.

Rejections Under 35 U.S.C. § 102(b) or 35 U.S.C. § 103(a)

Marrs

Claims 1, 2, 4, 6, 8 through 12, 14 through 20, 24 through 27, 29, 31, 33 through 37 and 39 through 45 were rejected under 35 U.S.C. § 102(b) as being anticipated by Marrs (U.S. Patent 5,701,034) or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Marrs

Applicants submit that a claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Brothers v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is contained in the claim. *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

Applicants further submit that to establish a *prima facie* case of obviousness under 35 U.S.C. § 103 three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of

ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Third, the cited prior art reference must teach or suggest all of the claim limitations. Furthermore, the suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on Applicants' disclosure.

Marrs discloses a packaged semiconductor die or dice including a heat sink with a locking feature. Semiconductor die 101 is attached to surface 110b of heat sink 110 with adhesive 113. Surface 110a of heat sink 110 may be exposed to the exterior of encapsulant 120 (See Col. 5, lines 3-7, 28-30, FIG.1).

Independent claims 1 and 25 recite an integrated circuit package that includes, among other things, an electrically conductive heat sink with "*the surface of the first portion* of the heat sink attached to the integrated circuit die" and a "*second portion* of the heat sink *projecting away from the first portion* of the heat sink." Independent claim 24 recites an integrated circuit package that includes, among other things, an electrically conductive heat sink with "*a vertically extending columnar portion surrounded by a horizontally extending skirt portion.*"

Marrs does not describe either explicitly or inherently such elements of the invention or teach, or suggest such a limitations regarding the claimed invention. Rather, Marrs discloses a heat sink 110 with a top surface 110b (heat sink die attach surface) and a bottom surface 110a which may be exposed to the exterior of the encapsulant. The heat sink in Marrs is disclosed as a single rectangular unit having one shape with a top and a bottom surface. In contrast, the present invention discloses a heat sink with *two distinguishable portions*, each with its own shape. The *two distinguishable portions* are clearly described in the specification and labeled in FIGS. 1A, 1B and 1C. Therefore, it is incorrect to analogize the top surface 110b of the heat sink in Marrs with the surface of the *first portion* of the heat sink in the present claimed invention of independent claims 1, 24 and 25. Likewise, the analogy between the bottom surface 110a of the heat sink in Marrs and the *second portion* of the heat sink *projecting away from the first portion*, as claimed in the present invention, is inappropriate as well.

It was asserted in the Office Action that the Applicants provide mere dimensional limitations that are prima facie obvious under 35 U.S.C. § 103 absent a disclosure that the limitations are otherwise critical. It is further asserted that it would have been an obvious matter of design choice to choose the particular relative dimensions of the heat sink. The Applicants respectfully disagree with such assertions. Applicants assert that the differences in heat sinks in Marrs and the present invention are not mere differences in dimensions. The present invention discloses a heat sink with two distinguishable portions, each portion having a distinguishable shape. Independent claims 1 and 25 recite a heat sink with"*the surface of the first portion* of the heat sink attached to the integrated circuit die" and a "*second portion* of the heat sink *projecting away from the first portion* of the heat sink." Independent claim 24 recites a heat sink with "*a vertically extending columnar portion surrounded by a horizontally extending skirt portion.*" Furthermore, the disclosure recites that the specific shape and design of the heat sink, where the *second portion* of the heat sink *projects away from the first portion* of the heat sink, provide *improvements* for the better performance by heat sinks of the present invention in comparison to conventional heat sinks. (See page 9, lines 4-29, page 10, lines 1-3, page 12, lines 4-9, page 13, lines 19-24).

Therefore, Marrs neither describes either expressly or inherently each and every element of independent claims 1, 24 and 25 to anticipate the claimed invention under 35 U.S.C. § 102, nor teaches or suggests each and every claim limitation of independent claims 1, 24 and 25 to establish a *prima facie* case of obviousness under 35 U.S.C. § 103. Accordingly, it is respectfully submitted that independent claims 1, 24 and 25 are neither anticipated by Marrs under 35 U.S.C. § 102 nor rendered obvious by Marrs under 35 U.S.C. § 103.

Claims 2, 4, 6, 8 through 12 and 14 through 20 are each allowable, among other reasons, as depending either directly or indirectly from independent claim 1, which is allowable.

Claims 26, 27, 29, 31, 33 through 37 and 39 through 45 are each allowable, among other reasons, as depending either directly or indirectly from independent claim 25, which is allowable.

For each of the foregoing reasons, it is respectfully submitted that, under 35 U.S.C.

§ 102(b) and § 103(a), each of the claims 1, 2, 4, 6, 8 through 12, 14 through 20, 24 through 27, 29, 31, 33 through 37 and 39 through 45 is allowable over Marrs. It is, therefore, respectfully requested that the § 102(b) and § 103(a) rejections of each of these claims be withdrawn.

Rejections Under 35 U.S.C. § 103(a)

Marrs in View of Wark

Claims 3, 22 and 28 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Marrs as applied to claims 1, 2, 4 through 6, 8 through 20, 24 through 27, 29 through 31 and 33 through 45, and further in combination with Wark (U.S. Patent 5,696,031).

The teachings of Marrs have been summarized herein.

Wark teaches a multi-chip module that is incorporated into a memory device in an electronic system that also includes an input device, an output device, and a processor device. The multi-chip module may be incorporated into any one or all of the input, output, and processor devices (See Col. 5, lines 59-65).

Independent claim 22 recites an integrated circuit package that includes, among other things, an electrically conductive heat sink with "*the surface of the first portion* of the heat sink attached to the integrated circuit die" and a "*second portion* of the heat sink being opposite the die-attach area and *projecting away from the first portion* of the heat sink."

Neither Marrs nor Wark, taken alone or in any combination, teaches or suggests such a limitation of the claimed invention. The foregoing reasons that the present invention is not rendered obvious under 35 U.S.C; § 103 by Marrs have been discussed hereinabove. Clearly, the cited prior art fails to establish a *prima facie* case of obviousness under 35 U.S.C. § 103.

Claims 3 and 28 are each allowable, among other reasons, as depending either directly or indirectly from independent claims 1 and 25 respectively, which are allowable.

Therefore, it is respectfully submitted that claims 3, 22 and 28 are allowable over the combination of Marrs and Wark as the cited prior art fails to establish a *prima facie* case of obviousness under 35 U.S.C. § 103. Accordingly, it is respectfully requested that the 35 U.S.C.

§ 103(a) rejections of claims 3, 22 and 28 be withdrawn.

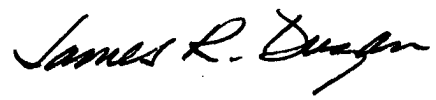
ENTRY OF AMENDMENT

It is respectfully submitted that the proposed amendments to claims 22, 24 and 25 should be entered by the Examiner because the amendments are supported by the as-filed specification and drawings and do not add any new matter to the application and clearly comply with the provisions of 35 U.S.C. § 132. The amendment should be entered as it is timely filed and clearly places the application in condition for allowance. Further, the proposed amendments do not raise new issues or require a further search.

CONCLUSION

Applicants request the entry of this amendment, the allowance of claims 1 through 4, 6, 7, 8 through 12, 14 through 20, 22, 24 through 29, 31, 32, 33 through 37, and 39 through 45, and the case passed for issue.

Respectfully submitted,



James R. Duzan
Attorney for Applicants
Registration No. 28,393
TRASKBRITT, PC
P.O. Box 2550
Salt Lake City, Utah 84110
(801) 532-1922

Date: August 27, 2002

JRD/sls:djp

Enclosure: Version with Markings to Show Changes Made

N:\2269\3056.1\Second Amendment Under 37 CFR 1.116.wpd